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REFRIGERATOR

Technical Field

The present invention relates to a refrigerator, and more particularly, to a refrigerant circulating device of the refrigerator.

Background Art

In general, a refrigerator is an apparatus for taking storage of foods freshly by keeping a low temperature in a freezing chamber and a refrigerating chamber. To maintain the low temperature in the freezing chamber and the refrigerating chamber, the refrigerator generates a cool air by using a freezing cycle of compressing-condensing-expanding-evaporating. Then, the generated cool air is provided to and circulated in the freezing chamber and the refrigerating chamber by using a supplying device, wherein the supplying device is comprised of a passage of supplying the cool air from the freezing cycle to the refrigerating chamber and the freezing chamber, and openings of discharging the cool air to the refrigerating chamber and the freezing chamber.

However, each opening is relatively smaller as compared with a volume in each of the freezing chamber and the refrigerating chamber, so that it is impossible to discharge a large amount of cool air to the refrigerating chamber and the freezing chamber in a short time. Especially, since the discharged cool air has a relatively high flowing speed, the discharged cool air flows to a specific direction from the openings, and more particularly, a straightforward direction. As a result, the cool air is not uniformly diffused in the entire refrigerating chamber and the entire freezing chamber.

Disclosure of Invention

An object of the present invention, designed for solving the foregoing problems, is to provide a refrigerator for uniformly providing a cool air to the inside.

The object of the present invention can be achieved by providing a refrigerator, the refrigerator includes a body; a refrigerating chamber and a freezing chamber provided in the body, for taking storage of foods; a cool air-generating device provided in the body, for generating a cool air; a cool air-supplying device including at least one opening for discharging the cool air, and for circulating the cool air through the freezing chamber, the refrigerating chamber, and the cool air-generating device; and a separator provided adjacent to the opening, for uniformly diffusing the cool air in the freezing chamber and the refrigerating chamber, by separating the cool air into at least two passages.

At this time, the separator is provided to block the discharged cool air. Also, the separator is extended in perpendicular to a flowing direction of the cool air.

The separator oscillates the discharged cool air. In more detail, the separator generates at least two vortexes in opposite, wherein the vortexes have size and intensity being different and continuously changed. Also, the separator is configured to allow the separated passages of the cool air to collide with each other before discharging the cool air. The separated passages of the cool air collide with each other in a straight line, and the separated passages of the cool air collide with each other at a predetermined angle.

At this time, the separator is formed of a flat member. In the meantime, the separator may be formed of a round shape being protruded in opposite to a flowing direction of the cool air. The separator may be formed of an angularly bent shape being protruded in opposite to a flowing direction of the cool air. Also, the separator may be formed of an oval shape to have both sides being round for the forward and opposite directions of the cool air. A plurality of protrusions or dimples may be formed on the surface of the separator.

Two opposite passages are formed between the separator and the opening, and the separated cool air flows along the two opposite passages. Also, the opening is positioned adjacent to a crossing point of meeting the separated passages of the cool air. In addition, an interval between the separator and the opening is equivalent to (or smaller than) a

width of the opening. Preferably, an interval between the separator and the opening is about 0.5 times of a width of the opening. Also, preferably, a width of the separator is equivalent to a width of the opening.

The opening is configured to discharge the generated cool air to the freezing chamber and the refrigerating chamber. Preferably, the opening is configured to discharge the generated cool air to the freezing chamber and the refrigerating chamber at least two different directions. Also, the opening is configured to discharge the generated cool air to the freezing chamber and the refrigerating chamber, the generated cool air discharged in perpendicular.

Also, the opening is configured to discharge the cool air circulated in the freezing chamber and the refrigerating chamber to the cool air-generating device. In more detail, the opening discharges the cool air circulated in the freezing chamber and the refrigerating chamber to an evaporator of the cool air-generating device. Preferably, the cool air-supplying device further includes an auxiliary duct extended adjacent to the evaporator of the cool air-generating device, for directly discharging the cool air circulated in the freezing chamber and the refrigerating chamber to the evaporator. The separator is positioned adjacent to an opening of the auxiliary duct.

The cool air-supplying device may include at least one duct of circulating the cool air from the cool air-supplying device to the opening. In this case, the duct may be expanded toward the inside of the refrigerating chamber and/or the freezing chamber. Preferably, the duct has an expanded portion adjacent to the separator. Also, a width of the expanded portion is about 2 to 2.5 times of a width of the corresponding duct, and a height of the expanded portion is about 1 to 1.2 times of a width of the corresponding duct. The duct is gradually expanded. More preferably, a sidewall of the expanded portion is inclined at a predetermined angle to a sidewall of the duct.

In the meantime, the refrigerator may have a plurality of openings and separators, wherein the separators are respectively positioned adjacent to the openings. In this case,

the adjacent separators oscillate the discharged cool air at a perpendicular direction. Preferably, the adjacent separators are configured to separate the discharged cool air at different directions. Also, the separator further includes one pair of supports extended from the opposite sides of the separator near to the opening, for supporting the separator, wherein each in one pair of supports from the adjacent separators supports the opposite side.

Accordingly, the cool air is uniformly diffused in the freezing chamber, the refrigerating chamber, and the evaporator.

Brief Description of Drawings

The accompanying drawings, which are included to provide a further understanding of the invention, illustrate embodiment(s) of the invention and together with the description serve to explain the principle of the invention. In the drawings:

FIG. 1 is a front view of a refrigerator according to the present invention;

FIG. 2 is a front section view of a refrigerator according to the first embodiment of the present invention;

FIG. 3 is a cross section view of a refrigerator according to the first embodiment of the present invention;

FIG. 4 is a partially expanded section view of a separator according to the first embodiment of the present invention;

FIG. 5A and FIG. 5B are schematic views of a cool air-supplying device according to the first embodiment of the present invention;

FIG. 6A and FIG. 6B are schematic views of a modified cool air-supplying device according to the first embodiment of the present invention;

FIG. 7 is a cross section view of a refrigerator according to the second embodiment of the present invention;

FIG. 8 is a partially expanded section view of a separator according to the second embodiment of the present invention;

FIG. 9A and FIG. 9B are cross section and schematic views of a modified refrigerator according to the second embodiment of the present invention;

FIG. 10A and FIG. 10B are schematic views of illustrating a modified duct applied to the first and second embodiments of the present invention;

FIG. 11A to FIG. 11C are schematic views of illustrating a modified separator applied to the first and second embodiments of the present invention; and

FIG. 12A and FIG. 12B are perspective and front views of illustrating a modified combination of a separator and an opening, applied to the first and second embodiments of the present invention.

Best Mode for Carrying Out the Invention

Reference will now be made in detail to the preferred embodiments of the present invention, examples of which are illustrated in the accompanying drawings. In describing the embodiments, parts the same with the related art fuel cell will be given the same names and reference symbols, and detailed description of which will be omitted.

Hereinafter, a refrigerator according to the present invention will be described with reference to the accompanying drawings.

FIG. 1 is a front view of a refrigerator according to the present invention. FIG. 2 is a front section view of a refrigerator according to the first embodiment of the present invention. FIG. 3 is a cross section view of a refrigerator according to the first embodiment of the present invention.

As shown in the drawings, the refrigerator according to the first embodiment of the present invention is largely provided with a body 10, a freezing chamber 30, a refrigerating chamber 40, a cool air-generating device, and a cool air-supplying device,

wherein the freezing chamber 30 and the refrigerating chamber 40 are provided inside the body 10.

First, the freezing chamber 30 freezes foods, and the refrigerating chamber 40 keeps foods in cold, so that foods are stored freshly. The freezing chamber 30 and the refrigerating chamber 40 are formed in a method of dividing an inner space of the body 10 by a barrier 20.

In the refrigerator according to the first embodiment of the present invention, the freezing chamber 30 and the refrigerating chamber 40 are positioned side by side. Alternatively, the freezing chamber 30 and the refrigerating chamber 40 may be positioned up and down.

The cool air-generating device is configured to generate a cool air discharged to the freezing chamber 30 and the refrigerating chamber 40. Also, the cool air-generating device is provided with a compressor, a condenser, an expanding valve, and an evaporator 71.

Herein, the compressor makes a low temperature/low pressure gaseous refrigerant to a high temperature/high pressure gaseous refrigerant, and the condenser condenses the gaseous refrigerant provided from the compressor. Also, the expanding valve lowers the pressure of the refrigerant provided from the condenser. Then, the evaporator 71 evaporates the refrigerant passing through the expanding valve in state of the low pressure, to absorb heats from the surrounding air. Thus, the surrounding air is changed to the cool air.

As shown in FIG. 3, the compressor and the condenser (not shown) are provided in a machine room 12 at a lower portion of the body 10. Also, the evaporator 71 is provided in an additional room adjacent to the freezing chamber 30 and the refrigerating chamber 40. In addition, a fan or a blower 72 is also provided in the additional room for being adjacent to the evaporator 71 so that the air is continuously circulated inside the refrigerator.

The cool air-supplying device discharges the cool air generated in the cool air-generating device to the freezing chamber 30 and the refrigerating chamber 40. Also, the cool air-supplying device provides the discharged cool air to the evaporator 71 for being cool again. That is, the cool air-supplying device continuously provides and circulates the cool air through the freezing chamber 30 and the refrigerating chamber 40, and more particularly, through the evaporator 71, whereby the freezing chamber 30 and the refrigerating chamber 40 are respectively maintained below a specific temperature. This cool air-supplying device may be provided with a first supplying part for the refrigerating chamber 40, and a second supplying part for the freezing chamber 30.

Referring to FIG. 2, the first supplying part is comprised of a first duct 50 for guiding the cool air to the refrigerating chamber 40, and first and second openings 51 and 52 for discharging the guided cool air to the refrigerating chamber 40.

As shown in FIG. 1 and FIG. 3, the first duct 50 is in communication with the room for the evaporator 71 by a first middle opening 21 provided in the barrier 20. Accordingly, the cool air is directly provided to the first duct 50 through the first middle opening 21.

The first and second openings 51 and 52 are positioned at the upper and lateral sides of the refrigerating chamber 40 for smoothly supplying the cool air to the refrigerating chamber 40. If necessary, the plurality of first and second openings 51 and 52 may be provided to the refrigerating chamber 40. Also, a second middle opening 22 is provided at a lower side of the barrier 20, wherein the second middle opening 22 is in communication with both the refrigerating chamber 40 and the freezing chamber 30. Thus, the cool air of the refrigerating chamber 40 is discharged to the freezing chamber 30 through the second middle opening 22.

The second supplying part is provided with a second duct 60 for guiding the cool air to the freezing chamber 30 and the evaporator 71, and at least one or more third and fourth openings 61 and 62 being in communication with the second duct 60.

As shown in FIG. 3, the second duct 60 is provided between the freezing chamber 30 and the evaporator 71. The second duct 60 is in communication with the evaporator 71 by a third middle opening 63, and the second duct 60 receives the cool air from the evaporator 71 by the fan 72. The third opening 61 discharges the cool air of the second duct 60 to the freezing chamber 30. The fourth opening 62 discharges the cool air of the freezing chamber 30 to the evaporator 71 so as to cool the air.

In this refrigerator according to the present invention, the air is cooled during passing through the evaporator 71 by the fan 72. Subsequently, the cool air is provided to the first duct 50 and the second duct 60 through the first middle opening 21 and the second middle opening 22. After that, the cool air is discharged to the refrigerating chamber 40 through the first opening 51 and the second opening 52, and is discharged to the freezing chamber 30 through the third opening 61.

However, as explained above, the cool air doesn't uniformly reach the freezing chamber 30 and the refrigerating chamber 40 due to the small-sized first, second, and third openings 51, 52, 61 and circulation speed/direction. Thus, in case of the refrigerator according to the first embodiment of the present invention, as shown in FIG. 2 to FIG. 4, separators 100 are provided to the openings 51, 52, 61 for discharging the generated cool air to the freezing chamber 30 and the refrigerating chamber 40.

As shown in FIG. 4, each of the separators 100 separates the cool air to at least two passages before discharging the cool air. That is, the separators 100 are provided adjacent to the openings 51, 52, 61, and more particularly, not inside the freezing chamber 30 and the refrigerating chamber 40 but inside the ducts 50, 60. According to the separation on passage of the cool air, it is possible to decrease the circulation speed of the cool air. Thus, it is very useful to diffuse the cool air in the freezing chamber and the refrigerating chamber.

Also, the separators 100 are provided to block the cool air, preferably, for being in perpendicular to the flowing direction of the cool air, thereby separating the cool air,

simultaneously, decreasing the circulation speed of the cool air. Preferably, the separators 100 are formed of flat members. Although not shown, the separators 100 of the flat members are respectively fixed to the inner surfaces of the ducts 50 and 60. Preferably, as shown in FIG. 2 and FIG. 3, the ducts 50 and 60 are expanded toward the inside of the freezing chamber 30 and the refrigerating chamber 40 so as to provide the cool air to the innermost of the freezing chamber 30 and the refrigerating chamber 40. Also, the openings 51, 52, 61 are provided to the ends of the ducts 50, 60. Accordingly, the additional characteristics related to the separators 100 are very advantageous to the uniform diffusion of the cool air inside the freezing chamber 30 and the refrigerating chamber 40.

Furthermore, before discharging the cool air, the cool air collides with the separators 100, thereby forming a chaos flow of unsteady state. At this time, the chaos flow generates several vortexes around the separators 100. In more detail, an adverse pressure gradient generates in a flow boundary layer formed on the surface of the separators 100, so that the separated passages of the cool air cause the separation at both ends of the separators 100. The separation generates at least two vortexes A between the separators 100 and the openings 51, 52, 61, so that the vortexes A flow to opposite directions at respective both ends of the separators 100. The vortex A has a specific frequency dependent on a shape and a dimension of the separator 100, and also has an intensity and a size being different from each other, and being varied continually. The discharged flow is excited by the vortexes between the separator 100 and the opening 51, 52, 61, and is progressing toward the inside of the freezing chamber 30 and the refrigerating chamber 40 by oscillating or swing. Accordingly, the cool air is uniformly diffused to the freezing chamber 30 and the refrigerating chamber 40.

Also, as shown in FIG. 4, the two passages are formed between the separator100 and the opening 51, 52, 61 by the separator 100. That is, the two passages are substantially opposite to each other, whereby the separated cool air flows along the two passages. The

passages substantially function as nozzles for partially forming the two passages as two jets B. According as the two jets B collide with each other in opposite or at a predetermined angle, a surrounding static pressure rises above an atmospheric pressure, thereby forming the flow of unsteady state. That is, this collision strengthens the vortex A generated by the separation of the cool air. Thus, the cool air oscillates greatly, so that the cool air is uniformly diffused and provided to the freezing chamber and the refrigerating chamber.

Also, as a time the excited cool air stays in the ducts 50, 60 becomes long, the oscillation of the cool air is lost due to the resistance on flow. That is, to obtain the maximum efficiency on diffusion of the flow, it is necessary to directly discharge the cool air maximumly excited by the vortexes A. Accordingly, the openings 51, 52, 61 are positioned adjacent to points of generating inference between the two vortexes A. Substantially, the cool air is excited maximumly at the point of the separated passages, that is, the point of meeting the jets B. In this respect, it is preferable to position the openings 51, 52, 61 for being adjacent to the point of meeting the jets B. In due consideration of the aforementioned explanation, if an interval H1 between the separator 100 and the opening 51, 52, 61 is larger than a width of the opening 51, 52, 61, the flow resistance to the excited cool air generates substantially. Preferably, the interval H1 is the same (or less than) as the width D2 of the opening 51, 52, and 61. In the meantime, in case of that the interval H1 is too small, it is hard to form and grow the vortexes A. Thus, preferably, the interval H1 is 0.5 times of the width D2 of the opening 51, 52, and 61. Also, on formation of the passage for the jets B and the vortexes A, it is useful to form the separator 100 in correspondence with the width D2 of the opening 51, 52, and 61.

With the separators 100, an orientation of the openings 51, 52, 61 is also very important for the uniform diffusion of the cool air, and this will be described with reference to FIG. 5A to FIG. 6B.

FIG. 5A and FIG. 5B are schematic views of a cool air-supplying device according to the first embodiment of the present invention. FIG. 6A and FIG. 6B are schematic views of a modified cool air-supplying device according to the first embodiment of the present invention. The cool air-supplying device will be described with the reference to FIG. 5A to FIG. 6B, which will be explained in comparison with FIG. 1 to FIG. 3.

First, as shown in FIG. 5A and FIG. 5B, the cool air-supplying device has openings for discharging the generated cool air at different directions. In more detail, the openings are comprised of first inlets 111 provided at a top wall of the freezing chamber 30 and the refrigerating chamber 40, and second inlets 112 provided at a sidewall of the freezing chamber 30 and the refrigerating chamber 40.

At this time, the first inlets 111 discharge the cool air toward the lower portion of the freezing chamber 30 and the refrigerating chamber 40. Also, the second inlets 112 discharge the cool air toward the upper portion of the opposite sidewall. Accordingly, the oscillated cool air is discharged from the different portions of the freezing chamber 30 and the refrigerating chamber 40 through the first and second inlets 111 and 112. That is, a substantial range of discharging the cool air becomes wide, so that it is advantageous to the uniform diffusion of the cool air in the freezing chamber 30 and the refrigerating chamber 40. To obtain the same result, the first and second inlets 111 and 112 may be positioned as shown in FIG. 5B. Especially, the first inlet 111 discharges the cool air in perpendicular to the cool air discharged from the second inlet 112.

As strengthening the inference and mixture in the cool air, a turbulent intensity of the cool air heightens. Thus, the oscillated cool air is uniformly diffused in the freezing chamber 30 and the refrigerating chamber 40. Simultaneously, it is possible to obtain a uniform temperature distribution. Also, the cool air-supplying device has outlets 120 for discharging the cool air of the freezing chamber 30 and the refrigerating chamber 40 to the external. The outlets 120 are provided at lower sides of the freezing chamber 30 and the refrigerating chamber 40, so that the cool air discharged from the inlets 111 and 112

is not directly discharged to the external. Preferably, the outlets 120 are provided on both lower sidewalls of the freezing chamber 30 and the refrigerating chamber 40, to discharge the cool air rapidly.

In connection with the freezing chamber 30, the second supplying part shown in FIG. 1 to FIG. 3 has only the third opening 61 corresponding to the second inlet 112. Referring to FIG. 1 to FIG. 3, in connection with the refrigerating chamber 40, the first supplying part has both the first and second openings 51 and 52 corresponding to the first and second inlets 111 and 112. Thus, in the refrigerator of FIG. 1 to FIG. 3, preferably, the second supplying part for the freezing chamber 30 has the additional opening corresponding to the first inlet 111. Also, in the freezing chamber 30, the outlet 120 corresponds to the fourth opening 62. In the refrigerating chamber 40, the outlet 120 corresponds to the second middle opening 22.

Preferably, as shown in FIG. 6A, the cool air-supplying device further includes third and fourth inlets 113 and 114, wherein the third and fourth inlets 113 and 114 function as openings. In this case, the third inlet 113 is provided at a lower portion in a sidewall of the freezing chamber 30 and the refrigerating chamber 40, below the second inlet 112. Thus, the third inlet 113 discharges the cool air toward a lower portion of an opposite sidewall. The fourth inlet 114 is provided on a bottom wall of the freezing chamber 30 and the refrigerating chamber 40, for discharging the cool air toward an upper portion of the freezing chamber 30 and the refrigerating chamber 40.

In the same way as the first and second inlets 111 and 112, the third inlet 113 discharges the cool air for being in perpendicular to the cool air discharged from the fourth inlet 114. By the additional third and fourth inlets 113 and 114, a substantial range of discharging the cool air becomes wide, so that a turbulent intensity of the cool air heightens. Also, the third and fourth inlets 113 and 114 generates a large turbulent flow in the center of the freezing chamber 30 and the refrigerating chamber 40, and also generates the same turbulent flow in the upper portion and the lower portion of the freezing chamber 30 and

the refrigerating chamber 40. Accordingly, the oscillated cool air is uniformly diffused in the freezing chamber 30 and the refrigerating chamber 40.

The third and fourth inlets 113 and 114 may be provided as shown in FIG. 6B, under the conditions of having the same effect. In relation to the refrigerator of FIG. 1 to FIG. 3, the first supplying part and the second supplying part respectively have the openings 51 and 61 corresponding to the third inlets 113. Accordingly, it is preferable for the first supplying part and the second supplying part to have the additional openings corresponding to the fourth inlets 114. Also, preferably, the outlet 120 is provided on the center of the sidewall of the freezing chamber 30 and the refrigerating chamber 40, not to directly discharge the cool air from the inlets 111, 112, 113, and 114 to the external. Eventually, as the openings are provided as shown in FIG. 5A to FIG. 6B, the discharged cool air generates the secondarily turbulent flow in the freezing chamber 30 and the refrigerating chamber 40, thereby giving the more uniform diffusion of the cool air.

In the meantime, since the evaporator 71 is wide, the cool air discharged from the fourth opening 62 is concentrated on the center of the evaporator 71. Accordingly, the heat-exchange efficiency of the evaporator 71 is lowered. Also, the heat exchange is not generated at the left and right sides of the evaporator 71, so that frosts may generated at the left and right sides of the evaporator 71, thereby lowering the heat-exchange efficiency. Thus, as shown in FIG. 7 to FIG. 9B, the separators 100 are provided in the fourth opening 62 for discharging the cool air circulated in the freezing chamber 30 and the refrigerating chamber 40 to the evaporator 71.

The separators 100 described in FIG. 8 have the same characteristics as the separators 100 of the first embodiment of the present invention explained with reference to FIG. 4. That is, the separator 100 separates the cool air into at least two passages before discharging the cool air, thereby decreasing the flow speed of the cool air. By the separation of the cool air, it is possible to form at least two vortexes A between the separator 100 and the opening 62. Also, two jets B are formed by the passage, wherein

the two jets B collide with each other, for strengthening the vortexes A. Thus, the cool air being oscillated is uniformly diffused to the entire evaporator 71.

Also, the opening 62 is provided adjacent to the crossing point of meeting the two jets B, so as to prevent the excited cool air from being lost. In the same reason, an interval H1 between the separator 100 and the opening 62 is same as (or smaller than) a width D2 of the opening 62. Preferably, the interval H1 is 0.5 times of the width D2 of the opening 62. For formation of the vortex A and the jet B, a width of the separator 100 is same as the width D2 of the opening 62.

To smoothly guide the oscillated cool air to the evaporator 71, preferably, as shown in FIG. 9A and FIG. 9B, the second supplying part may include an additional auxiliary duct 80. The auxiliary duct 80 is in communication with the fourth opening 80, and is extended for being adjacent to the evaporator 71. Furthermore, the auxiliary duct 80 includes an auxiliary opening 81 oriented toward the evaporator 71, and the separator 100 is provided adjacent to the auxiliary opening 81. Thus, as the cool air passes through the freezing chamber 30 and the refrigerating chamber 40, the cool air is oscillated by the separator 100, and is directly discharged to the evaporator 71. As a result, the cool air is uniformly diffused in the entire evaporator 71.

In both the aforementioned first and second embodiments of the present invention, it is possible to improve the efficiency of the separator 100 by modification, which will be explained with reference to FIG. 10A to FIG. 12B.

First, as shown in FIG. 10A, preferably, the first and second auxiliary ducts 50, 60, 80 are partially expanded at the portions adjacent to the separators 100. That is, the expanded portions 50a, 60a, 80a substantially enlarge the circumferential space adjacent to the separators 100, whereby the flow speed of the cool air is decreased in the expanded portions 50a, 60a, 80a. Thus, the separators 100 decrease the loss on flow resistance, and simultaneously, separate the cool air.

Preferably, the width D3 of the expanded portions 50a, 60a, and 80a is 2 to 2.5 times of the width D0 of the ducts 50, 60, and 80. The height H2 of the expanded portions 50a, 60a, and 80a is 1 to 1.2 times of the width D0 of the ducts 50, 60, and 80. Also, as explained in FIG. 4 and FIG. 8, the width D of the separator 100 is equivalent to (or smaller than) the width D0 of the ducts 50, 60, and 80, and the width D2 of the first to fourth openings and the auxiliary openings 51, 52, 61, 62, and 81. Also, the interval H1 is equivalent to (or smaller than) the width D2 of the openings 51, 52, 61, 62, and 81. Preferably, the interval H1 is 0.5 times of the width D2 of the openings 51, 52, 61, 62, and 81.

If the ducts 50, 60, and 80 extend rapidly and largely, the cool air momentarily has large resistance and great loss. Accordingly, as shown in FIG. 10B, the expanded portions 50a, 60a, and 80a have the structure of gradually expanding the ducts 50, 60, and 80. That is, the sidewalls of the expanded portions 50a, 60a, and 80a are inclined at a predetermined angle to the sidewalls of the ducts 50, 60, and 80. Thus, the expanded portions 50a, 60a, and 80a substantially decrease the energy loss generated by the flow resistance.

In case the separator 100 is formed of a flat member, the flow resistance is great on the cool air, thereby generating the loss in flowing the air (that is, energy loss). As described above, a drag coefficient of the flat member is 2.0. Accordingly, there is requirement for selecting a flowing separator 100 having a smaller drag coefficient, for obtaining the separation of the passage and the decrease of the flowing speed in state of decreasing the loss in the cool air.

First, as shown in FIG. 11A, the separator 100 may be formed in a curved shape. Also, the separator 100 is protruded in opposite to the flowing direction of the cool air. In this case, the drag coefficient of the separator 100 is about 1.40. Also, as shown in FIG. 11B, the separator 100 may be formed in an angularly bent shape, wherein the separator 100 may be protruded in opposite to the flowing direction of the cool air. The separator 100 has a drag coefficient of about 1.20.

Alternatively, as shown in FIG. 11C, the separator 100 may be formed in an oval shape to have both sides being round for the forward and opposite directions of the cool air. The oval-shaped separator 100 has a drag coefficient being varied on the circumferential flow boundary layer. More specifically, in case of forming a laminar boundary layer, the drag coefficient is smaller than a coefficient of the separator of FIG. 11B and FIG. 11C. In case of forming a turbulent boundary layer, the drag coefficient is much smaller. Also, a plurality of protrusions or dimples may be formed on the surface of the separator according to other modifications of the present invention. The protrusions or dimples induce the formation of the turbulent boundary layer around the separator 100, thereby decreasing the drag coefficient.

Meanwhile, the oscillation direction of the discharged cool air is regarded as the condition for improving the efficiency of the separator 100.

As shown in FIG. 12A and FIG. 12B, in the aforementioned first and second embodiments of the present invention, the plurality of openings 51, 52, 61, 62, and 81 are formed in each of the corresponding ducts 50, 60, and 80. In this case, the openings 51, 52, 61, 62, and 81 are provided adjacent to one another, and the ducts 50, 60 and 80 are connected with the openings. As shown in the drawings, one duct may be connected with the plurality of openings 51, 52, 61, 62, and 81 being adjacent to one another. Alternatively, the plurality of ducts may be respectively connected with the plurality of openings. The plurality of separators 100 are respectively provided to the openings 51, 52, 61, 62, and 81. In this state, the openings 51, 52, 61, 62, and 81 have the alternately changed sizes, and the respective separators 100 also have the sizes equivalent to the corresponding openings 51, 52, 61, 62, and 81.

Also, pairs of first supports 100a and pairs of second supports 100b are alternately extended from the opposite sides of the separators 100 to the openings 51, 52, 61, 62, and 81, to support the separators 100. Especially, the pairs of the opposite sides of the openings supported by the first supports 100a are different from the pairs of the opposite

sides of the openings supported by the second supports 100b. In more detail, as shown in the drawings, the first supports 100a support the left and right sides of the separators 100. Meanwhile, the second supports 100b support the lower and upper sides of the separators 100. According to this arrangement of the first and second supports 100a and 100b, the adjacent separators 100 separate the discharged cool air by the different directions. That is, the separators 100 separate the cool air by the lower and upper directions with the first supports 100a, and separate the cool air by the left and right directions with the second supports 100b.

After that, vortexes are generated at the lower and upper sides of the separators 100 by the first supports 100a, and then the cool air is oscillated up and down, and is discharged through the openings 51, 52, 61, 62, and 81. Also, vortexes are generated at the left and right sides of the separators 100 by the second supports 100b, and then the cool air is oscillated to the left and right sides, and is discharged through the openings.

Accordingly, the turbulent intensity of the flowing air firstly heightens in the ducts 50, 60, and 80, so that the oscillation of the cool air becomes greater. Also, the separators 100 oscillate the cool air at the different directions, for example, at the perpendicular direction. Thus, after the adjacent passages of the flowing air are discharged, the adjacent passages of the flowing air instantly interfere and mix with one another, thereby forming the severe turbulent flow. As a result, the discharged cool air is uniformly diffused in the freezing chamber and the refrigerating chamber.

Industrial Applicability

As mentioned above, the refrigerator according to the present invention has the following advantages.

In the refrigerator according to the present invention, the separators oscillate the discharged cool air, so that the discharged cool air is uniformly and entirely diffused in the freezing chamber, the refrigerating chamber, and the evaporator. Accordingly, it is

possible to perform the heat exchange in the refrigerating/freezing chambers in a short time, thereby improving the efficiency in the refrigerator.

It will be apparent to those skilled in the art that various modifications and variations can be made in the present invention without departing from the spirit or scope of the invention. Thus, it is intended that the present invention cover the modifications and variations of this invention provided they come within the scope of the appended claims and their equivalents.